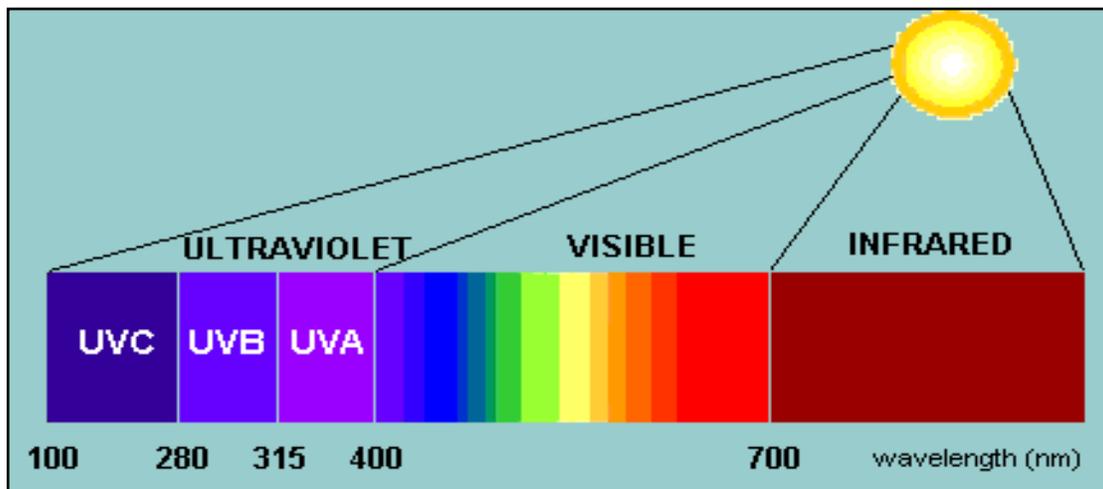


CRITICAL THINKING ACTIVITY: THE ELECTROMAGNETIC SPECTRUM



There are many kinds of energy in the universe. The energy given off from the sun is radiant energy, scientifically called *electromagnetic radiation*. Produced by nuclear reactions at the core of the sun, this energy streams from the surface of the sun in waves of different lengths. The shortest and longest wavelengths are invisible to our eyes, but the medium wavelengths are the visible radiation we call sunlight. Most of the sun's energy is released in these visible wavelengths.

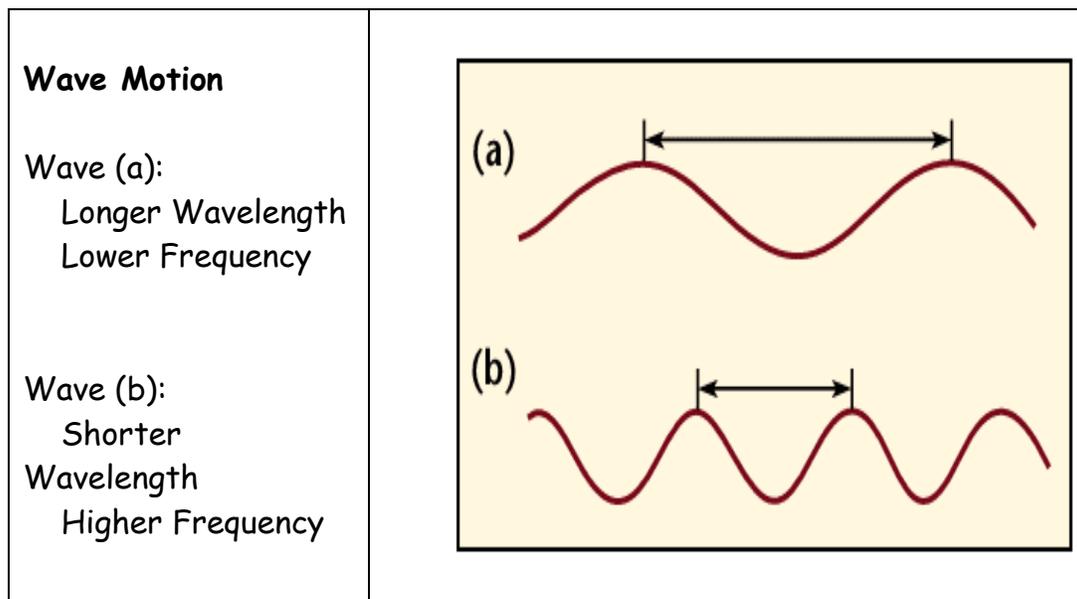


All substances have *kinetic energy* that is expressed by vibrations of their atoms or molecules. The vibrations result in radiation. The *electromagnetic (EM) spectrum* is a name given to all of the different types of radiation. Electromagnetic radiation is energy that spreads out as it travels. Visible light radiation that comes from a lamp in someone's house or radio wave radiation that comes from a radio station are two types of electromagnetic radiation. Other examples of EM radiation are microwaves, infrared and ultraviolet radiation, X-rays and gamma rays. Hotter, more energetic objects and events create higher energy radiation than cool objects. Only extremely hot objects or particles moving at very high speeds can create high-energy radiation like X-rays and gamma rays.

Student Sheet 2

A common assumption is that radio waves are completely different than X-rays and gamma rays. They are produced in very different ways, and we detect them in different ways. However, radio waves, visible light, X-rays, and all the other parts of the electromagnetic spectrum are fundamentally the same. They are all forms of electromagnetic radiation.

All substances give off electromagnetic radiation in the form of *electromagnetic waves*. The motion of different waves enables scientists to classify them into different parts of the electromagnetic spectrum.



Waves are measured by their *length (wavelength)* in meters. They are also measured by the number of waves that pass a point in space each second or their *frequency*. Electromagnetic waves vary in their lengths from very short waves (billionths of a centimeter) to very long waves (hundreds of kilometers). *It is important to remember that the various kinds of electromagnetic radiation differ only in their wavelength and frequency. They are alike in all other respects.*

However some electromagnetic radiation is strong enough to penetrate certain substances (skin, for example) while other forms are not. Similarly, some electromagnetic radiation is capable of causing damage to molecules and cells. You may know that people are cautioned to limit their time in the sun for this reason, since exposure to ultraviolet radiation can cause skin cancer.

PROPERTIES OF ELECTROMAGNETIC RADIATION

1-1)

1-2)

1-3)

1-4)

1-5)

1-6)

RESEARCH GUIDE



GROUP 1: RADIO WAVE RADIATION

1. Define radio wave radiation:
2. Describe where radio waves are found on the EMS compared to the other six forms of radiation. In your description, compare and contrast it with *wavelength, frequency and energy* with those of other regions of the EMS.
3. Are there human health risks from exposure (or overexposure) to radio wave radiation? If so:
 - Describe the main risk(s).
 - Describe common sources of exposure (or overexposure).
 - Describe a technology, device, or behavior that can be used for protection, or to decrease exposure.
4. Describe how radio waves are used in cell phone wireless communication technology.

(Description ↓)

(Drawing ↓)



RESEARCH GUIDE

GROUP 2: MICROWAVE RADIATION

1. Define microwave radiation:
2. Describe where microwaves are found on the EMS compared to the other six forms of radiation. In your description, compare and contrast its *wavelength, frequency and energy* with those of other regions of the EMS.
3. Are there human health risks from exposure (or overexposure) to microwaves? If so:
 - Describe the main risk(s).
 - Describe common sources of exposure (or overexposure).
 - Describe a technology, device, or behavior that can be used for protection or to decrease exposure.
4. Describe how a microwave oven uses microwaves to quickly heat food.

(Description ↓)

(Drawing ↓)



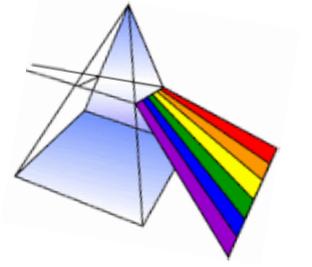
RESEARCH GUIDE

GROUP 3: INFRARED RADIATION

1. Define infrared radiation:
2. Describe where infrared is found on the EMS compared to the other six forms of radiation. In your description, compare and contrast its *wavelength, frequency and energy* with those of other regions of the EMS:
 2. Are there human health risks from exposure (or overexposure) to infrared radiation? If so:
 - Describe the main risk(s).
 - Describe common sources of exposure (or overexposure).
 - Describe a technology, device, or behavior that can be used for protection or to decrease exposure.
4. Describe how infrared technology can be used to enable people to "see" in the dark

(Description ↓)

(Drawing ↓)



RESEARCH GUIDE

GROUP 4: VISIBLE LIGHT RADIATION

1. Define visible light radiation:
2. Describe where visible light is found on the EMS compared to the other six forms of radiation. In your description, compare and contrast its *wavelength, frequency and energy* with those of other regions of the EMS.
3. Are there human health risks from exposure (or overexposure) to visible light? If so:
 - Describe the main risk(s).
 - Describe common sources of exposure (or overexposure).
 - Describe a technology, device, or behavior that can be used for protection, or to decrease exposure.
3. Describe how visible light is used with solar photovoltaic panels to produce electricity.

(Description ↓)

(Drawing ↓)

RESEARCH GUIDE

GROUP 5: ULTRAVIOLET RADIATION



1. Define ultraviolet radiation:
2. Describe where ultraviolet is found on the EMS compared to the other six forms of radiation. In your description, compare and contrast its **wavelength, frequency and energy** with those of other regions of the EMS.
3. Are there human health risks from exposure (or overexposure) to ultraviolet radiation? If so:
 - Describe the main risk(s).
 - Describe common sources of exposure (or overexposure).
 - Describe a technology, device, or behavior that can be used for protection, or to decrease exposure.
4. Describe how ultraviolet radiation is used in tanning bed technology.

(Description ↓)

(Drawing ↓)

RESEARCH GUIDE

GROUP 6: X-RADIATION



1. Define X-radiation:
2. Describe where X-rays are found on the EMS compared to the other six forms of radiation. In your description, compare and contrast its **wavelength, frequency and energy** with those of other regions of the EMS.
3. Are there human health risks from exposure (or overexposure) to X-rays? If so:
 - Describe the main risk(s).
 - Describe common sources of exposure (or overexposure).
 - Describe a technology, device, or behavior that can be used for protection, or to decrease exposure.
4. Describe how X-radiation can be used to produce an internal image of the body.

(Description ↓)

(Drawing ↓)



RESEARCH GUIDE

GROUP 7: GAMMA RADIATION

1. Define gamma radiation:
2. Describe where gamma rays are found on the EMS compared to the other six forms of radiation. In your description, compare and contrast its *wavelength, frequency and energy* with those of other regions of the EMS.
3. Are there human health risks from exposure (or overexposure) to gamma radiation? If so:
 - Describe the main risk(s)
 - Describe common sources of exposure (or overexposure)
 - Describe a technology, device, or behavior that can be used for protection, or to decrease exposure.
4. Describe how gamma radiation may be used to treat cancer.

(Description ↓)

(Drawing ↓)